REMARKS

In the Office Action, the Examiner indicated that claims 1 through 20 are pending in the application and the Examiner rejected all claims.

Claim Rejections, 35 U.S.C. §112

At item 1 of the Office Action, the Examiner rejected claims 2, 16, 17, 19, and 20 under 35 U.S.C. §112, first paragraph. By this amendment, claim 2 has been amended to correct an obvious typographical error. It is submitted that this claim amendment overcomes the rejection of claim 2 under 35 U.S.C. §112, first paragraph.

The Examiner also rejected claims 16, 17, 19, and 20 under 35 U.S.C. §112, first paragraph, asserting that the phrases "particular stock choice", "particular stock market", "mutual funds", and "futures" are not defined by the disclosure. These terms are elementary investment terms that are known to most members of the general public, and that are certainly well known in the field of stock market forecasting. Applicant is not required to provide definitions for such well known terms:

> "An applicant's specification must convey with reasonable clarity to those skilled in the art that as of the filing date sought he or she was in possession of the invention, i.e., whatever is now claimed." MPEP §2163, citing *Vas-Cath, Inc. v. Mahurlar*, 935 F2d 1555, 1563-64 (Fed.Cir. 1991)

The terms used provide the reasonable clarity required. Accordingly, applicant submits that claims 16, 17, 19, and 20 meet the requirements of 35 U.S.C. §112, first paragraph. The Examiner is respectfully requested to reconsider and withdraw the rejection of the claims under 35 U.S.C. §112.

Claim Rejections, 35 U.S.C. §102

In item 3 on pages 3-6 of the Office Action, the Examiner rejected claims 1, 2, 7-9, and 14-20 under 35 U.S.C. §102(b) as being anticipated by Chidambaran et al. (IEEE 98th8367).

The Present Invention

The present invention is a fuzzy logic system with evolutionary variable rules. According to the present invention, the features, qualifiers, and operators of rules, and the rules themselves, are continually generated and evolved using genetic algorithms, based on real-time data. This invention is especially useful in stock market forecasting and, in particular, day-trading wherein the pertinent data may change many times over a short period of time.

The method of the present invention is as follows: first, a random set of rules (a population of chromosomes) is generated using a random selection from each of the categories of operators, features, cases, and qualifiers. Next, the population of chromosomes are evolved to improve their fitness function in a known manner. The fitness function is a cost function that penalizes the algorithm if it renders non-compliant results, i.e., results that do not logically follow the trend of the input data.

Once the fitness function plateaus for the population (i.e., ceases to improve) the resultant rule (a chromosome) is stored, e.g., in a bin, thereby creating a storage location or "binning pool" in which "optimized" rules are accumulated. The chromosomes then go through further generation (initialization) and evolution to improve their overall fitness function. The chromosomes that are subjected to this further evolution may be a set of newly generated chromosomes (including chromosome(s) from the previous evolutionary session). This process is repeated until adding more chromosomes to the optimized rule pool does not improve the overall fitness of the pool. At this point the algorithm may be

stopped and the best chromosomes then define the rules of the system. For example, if it is presumed that a optimized chromosome pool population can contain 15 chromosomes, then once 16 chromosomes have been established, an evaluation is made and the 15 fittest chromosomes are kept while the worst of the 16 is deleted.

Thus, the fuzzy logic system of the present invention creates fuzzy rules in real-time and updates the fuzzy rules dynamically. This is accomplished by continually optimizing the features, qualifiers, cases, and operators of the fuzzy rules. The fuzzy logic system may be utilized in applications requiring constantly-updated fuzzy rules and also in applications where fuzzy rules are difficult to pre-define due to a large quantity of input data, such as, for example, stock market forecasting.

The Chidambaran et al. Reference

Chidambaran et al. teach the use of genetic programming to create a computer program that approximates the relationship between the price of a stock option, the terms of the option contract, and the properties of the underlying stock price that forms the basis for the stock option. Using genetic program, the authors of the Chidambaran et al. reference claim that they can create a computer program that achieves a better solution to the problem (approximating the relationship between the option price, the option contract and the underlying stock price) than the "Black-Scholes" option pricing model, a widely accepted option pricing theory used in financial markets at the time of the writing of the Chidambaran et al. reference. In accordance with Chidambaran et al., the steps of the evolutionary program are repeated for a "pre-specified number of times" and then the steps are terminated.

The Hung Reference - (U.S. Patent No. 5,727,130)

Hung teaches a genetic algorithm for constructing and tuning a fuzzy logic system. The Examiner relies on Hung for an alleged teaching of the evolving of features of random rules (Hung, column 123, lines 6-10) and a teaching of using an interface of genetic algorithm with fuzzy logic systems to eliminate manually building fuzzy systems (column 3, lines 18-20).

The Cited Prior Art Does Not Anticipate the Claimed Invention

The MPEP and case law provide the following definition of anticipation for the purposes of 35 U.S.C. §102:

> "A claim is anticipated only if each and every element as set forth in the claim is found, either expressly or inherently described, in a single prior art reference." MPEP §2131 citing *Verdegaal Bros. v. Union Oil Company of California*, 814 F.2d 628, 631, 2 U.S.P.Q. 2d 1051, 1053 (Fed. Cir. 1987)

The Examiner Has Not Established a *prima facie* Case of Anticipation

The Chidambaran et al. reference is limited to genetic programming. As is well known, genetic programming provides a method for automatically creating a working computer program by genetically breeding a population of computer programs using the principles of Darwinian natural selection and biologically inspired operations. A (typically large) grouping of individual programs in a population is evaluated to determine how fit it is at solving the problem at hand. Programs are then probablistically selected from the population based on their fitness to participate in the various genetic operations, with reselection allowed. While a more fit program has a better chance of being selected, even individual programs known to be unfit are allocated some trials in a mathematically principled way. After many generations, a program emerges that solves, or approximately solves, the problem at hand.

A genetic algorithm is an algorithm that is created based on natural biological evolution. A genetic algorithm functions by generating a large set of possible solutions to a given problem. It then evaluates each of those solutions, and decides on a "fitness level" for each solution set. These solutions then breed new solutions. The parent solutions that were more "fit" are more likely to reproduce, while those that were less "fit" are more unlikely to do so. In essence, solutions are evolved over time.

The present invention has two independent claims: claim 1 and claim 9. The Examiner has rejected each of these claims, including certain of the claims depending from these independent claims, based upon the Chidambaran et al. reference. This rejection is respectfully traversed. As noted above, the Chidambaran et al. reference is related to genetic programming. Further, as admitted by the Examiner, the Chidambaran et al. reference teaches that the evolutionary process for generating the computer program is repeated "for a pre-specified number of times". In other words, a number of generations to evolve is selected ahead of time, and then when this number is reached, the process is completed.

By contrast, the present invention, as specifically claimed in both independent claims 1 and 9, involves the use of genetic algorithms to improve the fitness function of rules in a random rule set in a fuzzy logic system. The evolutionary process continues not for a finite, pre-determined number of generations; instead, it continues until the fitness function of the rules cannot be further improved, i.e., becomes substantially constant, indicating that it has reached a plateau. Independent claims 1 and 9 each specifically recite these features not taught or suggested by Chidambaran et al. (e.g., Claim 1: "...evolving said random rules using a genetic algorithm to improve the sitness function of said rules in said random rule set until the overall fitness function of said rules plateaus, thereby generating an optimized rule ...."). As a result, an optimized rule is generated.

The development disclosed in the Chidambaran et al. reference cannot perform this function. First, its purpose is to generate a computer program, not to improve the fitness function of rules in a random rule set of a fuzzy logic system. Further, once the predetermined number of generations has elapsed, the process of Chidambaran et al. terminates, regardless as to whether or not any plateauing has taken place and, thus, regardless as to whether or not the computer program being generated is "optimized".

To summarize, the present claimed invention specifically claims the use of a genetic algorithm; the Chidambaran et al. reference is specifically limited to genetic programming. Further, the genetic algorithms of the present invention are continually repeated until a plateau is reached, which results in an optimized rule set; the development taught in the Chidambaran et al. reference, simply evolves for a predetermined number of generations, regardless of the outcome. For these reasons alone, the present claimed invention as claimed in claims 1 and 9, and all claims depending therefrom (claims 2-8 and 10-20), patentably define over the prior art and are in condition for allowance.

Claim Rejections, 35 U.S.C. §103

In item 4 on pages 6-9 of the Office Action, the Examiner rejected claims 3-6, and 10-13 under 35 U.S.C. §103(a) as being unpatentable over Chidambaran et al. in view of U.S. Patent No. 5,727,130 to Hung.

The Examiner has not Established a *prima facie* Case of Obviousness

As set forth in the MPEP:

> To establish a *prima facie* case of obviousness, three basic criteria must be met. First, there must be some suggestion or motivation, either in the references themselves or in the knowledge generally available to one of ordinary skilled in the art, to modify the reference or to combined reference teachings. Second, there must be a reasonable expectation of success. Finally, the prior art reference (or references when combined) must teach or suggest all the claim limitations. MPEP 2143

First, these claims depend from independent claims 1 and 9 which, as noted above, patentably define over the prior art. The addition of the Hung reference does not render these claims obvious. The Examiner asserts that U.S. Patent No. 5,727,130 to Hung teaches evolving features of random rules at column 123, lines 6-10. This is incorrect. The cited portion of Hung teaches the production of chromosomes representing "input membership functions and rules for a fuzzy logic system." Applicant admits that Hung teaches the evolution of fuzzy rules using GA's, see specification, page 5, lines 11-19. As further set forth therein, however, Hung does not teach or suggest the evolution of "variables, such as features, qualifiers, and operators ...".

Each of claims 3-6 and 10-13 specifically claim the evolution of features, qualifiers and/or operators. Thus, Hung fails to teach or suggest the recited elements of claims 3-6 and 10-13. Accordingly, these claims patentably define over both Chidambaran et al. and Hung, either taken alone or in combination.

Conclusion

The present invention is not taught or suggested by the prior art. Accordingly, the Examiner is respectfully requested to reconsider and withdraw the rejection of the claims. An early Notice of Allowance is earnestly solicited.

Attached hereto is a marked-up version of the changes made to the claims by the current amendment. The attached page is captioned "Version with markings to show changes made."

Enclosed herewith, in triplicate, is a Petition for extension of time to respond to the Examiner's Action. The Commissioner is hereby authorized to charge any additional fees or credit any overpayment associated with this communication to Deposit Account No. 19-5425.

Respectfully submitted,

7/29/02
Date

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Enclosures

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Version with Markings to Show Changes Made

Claim 2 has been amended as follows.

2. (Amended) A method as set forth in claim 1, wherein said generating step includes the steps of:

checking said optimized rule storage area to determine if it contains any optimized rules; and

using any [optical] optimized rules contained in said optimized rule storage area when generating said pool of random rules.